Do Dogs Experience Cognitive Dissonance?

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Abstract

The effort justification paradigm – wherein people prefer rewards requiring more effort – is often explained by cognitive dissonance (discomfort experienced when by holding contradictory beliefs and/or behaviors). Contrast theory provides an alternative by explaining that this preference is due to a greater difference between participant's starting and ending hedonic states. To differentiate these theories, dogs participated in an effort justification paradigm, hearing a severely or mildly annoying noise before receiving one of two differently colored treats. Afterwards, they were given a preference test. Cognitive dissonance and effort justification theories both expect dogs to prefer the treat associated with the severe noise. However, when the treat is not contingent on the noise, contrast theory predicts dogs to prefer the treat associated with the severely annoying noise and cognitive dissonance theory predicts no preference. The results were inconclusive – the effort justification effect was not found in the contingent or non-contingent treatment. Thus, it is still too soon to tell whether dogs or other animals experience cognitive dissonance.

Do Dogs Experience Cognitive Dissonance?

Though their histories may be comparatively short to other scientific disciplines, social and cognitive psychology have made many discoveries about human nature. Looking at these discoveries as a whole, it seems safe to say that human beings are not always completely rational. Take for example, the availability heuristic – the tendency to rely on examples that come to mind most easily when making evaluations or decisions (Tversky & Kahneman, 1973). Many people fear traveling by plane more than by car simply because plane accidents are reported in the news more often than car accidents – even though car accidents are much more common (Mouawad & Drew, 2013). Another example is confirmation bias. When people are confronted with large amounts of information on a topic, they pay attention only to facts that support their preconceptions and ignore those that challenge them (Wason, 1960). A bad first impression of someone can easily lead one to form bad second and third impressions of them if one's mind refuses to pay attention to their good side. Moreover, those who think none of these biases apply to them are probably exhibiting the superiority bias (Hoorens, 1993). Most relevant to the current paper, however, is a bias called cognitive dissonance.

People experience cognitive dissonance when they hold two contradictory beliefs (for example, believing you are not judgmental while simultaneously thinking someone is stupid based on their music tastes) or when they behave in a way that contradicts one of their beliefs (for example, sharing a secret about a friend even though you consider yourself a loyal to them)(Festinger, 1962). This dissonance is "psychologically uncomfortable" and motivates people to reduce or eliminate it by either changing their inconsistent beliefs or by changing their inconsistent behavior (Festinger, 1962). Take, for example, a dieter who begins eating an unhealthy piece of cake. Upon viewing the nutrition facts, the dieter experiences cognitive dissonance between her behavior (eating the cake) and one of her beliefs ("I should eat healthy food"). She is likely to reduce this dissonance by either changing her behavior (stop eating cake) or her belief ("the cake is not *that* unhealthy").

Cognitive dissonance has been demonstrated in a number of different ways and through a few different experimental paradigms. In each case, people are first put in a dissonance-provoking situation and then tested to see if they behave in a way that reduces this dissonance. Most relevant to the current study is a method of studying cognitive dissonance called the effort justification paradigm. This paradigm is based on the idea that the more effort a person puts towards achieving an outcome, the more they will value that outcome (Aronson & Mills, 1959). For example, if someone drives 45 minutes to see a mediocre movie, he is more likely to review it positively than if he had driven 5 minutes to see the movie at his local theater. This is because he is more likely to experience dissonance between his behavior (driving 45 minutes) and his belief ("the movie was mediocre"). Hence, he is more likely to tell himself he liked the movie as a way to reduce this dissonance. To put effort justification simply, more effort leads to more dissonance which leads to more self-deception – i.e., rating the outcome higher.

The effort justification paradigm, then, has a basic logic to it –participants undergo one of two tasks, one severely unpleasant or one mildly unpleasant, and then are rewarded for it (Aronson & Mills, 1959). After being rewarded, they then rate the reward. In most cases, participants who were given the severely unpleasant task (Group *S*) rate the reward higher than those given the mildly unpleasant task (Group *M*). According to cognitive dissonance theory, Group *S* rates the reward higher than Group *M* because they experience more dissonance between their behavior (working hard for a reward) and their attitude ("this reward is mediocre"). Because Group *S* experiences more dissonance, they are more likely than Group *M* to reduce this dissonance by rating the reward positively.

One of the first experiments using this paradigm investigated whether this effect plays a role in people's feelings towards social groups after a difficult initiation process. Participants were told they would be screened in order to join a discussion group on the psychology of sex. This screening required passing an "embarrassment test" in which participants had to read note cards containing sexually explicit words to an audience. One group (Group *S)* of participants read explicit words like "fuck", "cock", and "screw". Another group (Group *M*) read less explicit, though still embarrassing words such as "prostitute", "virgin" and "petting". All participants were told they passed the "initiation" and listened to what they thought was the group discussing sexual behavior in animals. This discussion was intentionally made as boring as possible. Participants then completed a questionnaire consisting of several evaluative scales asking them to rate different aspects of the discussion group in terms of intelligence, interestingness, etc. on separate scales, each from 0 to 15. The sum of these scales showed that Group *S* viewed the discussion group more positively (M=195, SD = 31.9) than Group *M* (M=171, SD = 34.0) (Aronson and Mills, 1959).

The cognitive dissonance explanation for these results was that the group who put more effort towards an unworthy reward (Group S) experienced more dissonance than the group who put less effort towards it (Group M) and therefore compensated by rating it positively. However, this is not the only way to interpret effort justification studies. An alternative explanation comes from contrast theory, which explains the difference in how participants rated the discussion groups through a purely behaviorist approach (Clement, Feltus, Kaiser, & Zentall, 2000). Contrast theory argues that when someone puts effort into a task or endures something unpleasant, they are put into a negative hedonic state (i.e., a state of unpleasantness; Aw et al., 2011). The more unpleasant the task, the more negative the hedonic state. When they are rewarded, their hedonic state improves, shifting to a positive value. It is therefore the change in hedonic state (from negative to positive) that drives people's perceived enjoyment of the group. Because Group S's hedonic state was initially more negative, when it shifted to positive the shift was greater than Group M's shift (See *Figure 1*).

Using Aronson and Mills' experiment as an example, Group *S* has to read a more embarrassing passage than Group *M* in order to make it into the discussion group. Because of this, Group *S* is put in a more negative hedonic state than Group *M*. Both groups are then rewarded with initiation to the discussion group, bringing both of them to an equal, positive hedonic state. But because Group *S* comes from a more negative state before being rewarded, it goes through a greater switch from negative to positive – in other words, there is greater contrast. This greater contrast causes Group *S* to rate the discussion group more positively than Group *M* (See *Figure 1*; Clement et al., 2000).

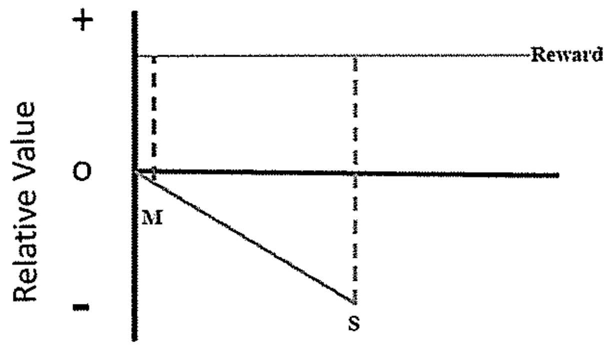

Figure 1. Contrast theory. This figure illustrates how contrast theory explains the effort justification effect by the difference in how their hedonic state changes. The high effort group (S) experiences a greater change in conditions when rewarded than the low effort group (M) and thus rates the reward more positively (Adapted from Clement et al., 2000).

The crucial difference between cognitive dissonance and contrast theory is how each of them views the role of the negative task prior to the reward. Contrast theory argues that the entire role of the task is to put participants in a negative hedonic state before the reward puts them in a positive state. This change in hedonic states is all that matters. Cognitive dissonance, on the other hand, views the task as playing a larger role – not only does it make the participant feel unpleasant, but it is also used as a part of a mental calculation that compares it to the value of the reward. If the value of the task and the reward does not match (the reward does not seem like it was worth it), the subject increases the perceived value of the reward, thereby reducing any dissonance.

The advantage of contrast theory over cognitive dissonance, however, is that it is more parsimonious. It doesn't require any discussion of cognitive processes or involve evaluating how behaviors and attitudes match. This has made researchers treat it as a more likely candidate explanation for effort justification experiments, at least those done with animals (Clement et al., 2000; Lydall et al., 2010). These animal experiments follow a similar setup as effort justification experiments done with humans, although some use a within subjects rather than between subjects design. Animals endure both severe and mild conditions to receive rewards (one corresponding to severe, one corresponding to mild) and then are given a preference test. Again, they prefer the reward associated with the severe condition (Clement et al., 2000; Lydall et al., 2010). For example, rats were trained to press a lever to gain access to a sucrose dispenser. One group of rats had to press the lever 10 times (Group M) and the other group – 50 times (Group S). Both groups were given the same sucrose reward, yet Group S produced more licks/lick clusters of the sucrose dispenser than Group M, indicating a greater preference for it (Lydall et al., 2010).

Cognitive dissonance would explain these results by saying that when the animals endured the more unpleasant activity, they experienced dissonance between their behavior (pecking keys or being shocked) and their belief about the value of the reward ("the reward is mediocre"). The animals reduced this dissonance by changing this belief, increasing their perceived value of the reward. Because the severely unpleasant task produces more dissonance than the mildly unpleasant task, they value its reward more than the mild task's reward – even though the rewards are basically the same. The problem with this explanation, contrast theory proponents argue, is that it assumes too much about the inner workings of the animals' minds. Why assume anything about animals forming beliefs or experiencing dissonance when a simpler explanation is available (Lydall et al., 2010)? Contrast theory explains these results without relying on the assumption that these animals are capable of forming and comparing beliefs. Instead, it argues that, because the animals put in more effort (more pecks or higher intensity shocks) they are brought to a more negative hedonic state and they experience a greater improvement in conditions when they are rewarded. This greater improvement in conditions is why they show a preference (Clement et al., 2000; Lydall et al., 2010).

The results of these animal effort justification experiments suggest that the results of human effort justification experiments could also be due to a contrast effect. However, before the animal experiments were even conducted, Gerard and Mathewson (1966) recognized the possibility that participants' preference for the high effort reward could simply be due to a contrast effect and redesigned the Aronson and Mills' original experiment to address this possible alternative explanation. Rather than read embarrassing words, participants received either mild or highly painful shocks to make them endure something unpleasant before rating a discussion group. More importantly, however, they added a crucial change to the original experiment by separating participants into an "initiation" or "non-initiation" treatment.

This change was crucial because of a major difference between cognitive dissonance and contrast theory. This difference is that contrast theory does not require participants to form any association between the unpleasant task and reward. It predicts that participants will prefer the reward following the more unpleasant task even if they do not think they 'earned' the reward- that is, even if they perceive no relationship between the task and reward. The unpleasant task simply puts them in a negative hedonic state and the reward in a positive hedonic state, whether or not the task and reward seemed related. Cognitive dissonance, on the other hand, requires participants to form an association between task and reward because they can only experience dissonance if there is a discrepancy between their behavior and attitude. In other words, they can only experience dissonance if they can feel like the reward wasn't 'worth it' or that their effort was wasted.

With this difference in the theories in mind, Gerard and Mathewson (1966) developed a way of testing which theory was the better explanation by introducing an 'initiation' and 'non-initiation' treatment. They gave participants a number of different stimuli to experience, including being sprayed with perfume, viewing paintings, and, critically, being shocked (with either severe or mild shocks). However, whereas all of the participants in Aronson and Mill's(1959) study were under the impression that reading the embarrassing words was part of the initiation into the discussion group, here only half of the participants were given reason to believe their response to the shocks affected their chances of being initiated. The experimenters did not tell the other half of participants the shocks had anything to do with joining the discussion group and thus were given no reason to associate the shocks with the discussion group. Rather, the researchers had them believe the shocks were just part of another set of stimuli from the series of stimuli to experience (Gerard and Mathewson, 1966).

Gerard and Mathewson found that in the "initiation" treatment, participants rated the reward following high shocks more positively than the reward following mild shocks, whereas participants in the "non-initiation" treatment rated them equally. In other words, participants in the "initiation" treatment demonstrated the effort justification effect but those in the "non-initiation" treatment did not. This contradicts the predictions of contrast theory while supporting the predictions of cognitive dissonance. Again, this is because contrast theory predicts that the effort justification effect will happen in both treatments -- whether participants perceive a relationship between their effort and the reward or not – and cognitive dissonance predicts the effort justification effect will only happen in the "initiation" treatment because dissonance cannot occur if the participants do not think there is a discrepancy between their effort and the reward (Gerard and Mathewson, 1966).

Replicating Gerard and Mathewson's Replication

Researchers have made the case that contrast theory is the better explanation for the effort justification effect in nonhuman animals because it is less complex than cognitive dissonance (Clement et al., 2000; Lydall et al., 2010). As of yet, however, no one has implemented Gerard and Mathewsons' alteration to the effort justification paradigm with animals. Gerard and Mathewson (1966) cast doubt on contrast theory by separating participants into initiation and non-initiation treatments, only finding the effort justification effect in the "initiation" treatment. It should be possible to replicate Gerard and Mathewson's version of the effort justification paradigm with nonhuman animals using the same manipulation.

Replicating Gerard and Mathewson's version of the effort justification paradigm serves a few purposes. First and most important, it is a definitive way of testing these two theories, rather than assuming that nonhuman animals are demonstrating a contrast effect in the effort justification paradigm. If the effect is found only in the "initiation" treatment, contrast theory can be ruled out as an explanation because contrast theory predicts the effort justification effect to happen in both treatments (since contrast theory views both treatments as essentially the same). If this is the case, it would imply that cognitive dissonance is not unique to humans and perhaps suggest that it is more ingrained in us than previously supposed. It would also further strengthen the cognitive dissonance explanation for Aronson and Mills' experiment. If the effect is found in both the "initiation" and "non-initiation" treatment, contrast theory still remains a viable explanation because it implies that the effort justification effect does not require subjects to perceive a relationship between their effort and the reward but rather is just matter of going through a greater change of hedonic state. Second, if the effect is found with a new species, even in both the "initiation" and "non-initiation" treatment, it expands the range of animals the effort justification effect applies to.

Replicating Gerard and Mathewson's experiment requires two treatments: one like the "initiation" condition in which the animals know they are being rewarded for undergoing an unpleasant experience (referred to as the "contingent treatment") and one like the "non-initiation" condition in which the animals do not perceive a relationship between the reward and unpleasant experience (referred to as the "non-contingent" treatment). In each treatment, animals will be subjected to very unpleasant and mildly unpleasant noises. They will be rewarded with a reward uniquely corresponding to which noise they heard. Then, after multiple trials, the dogs will be given a preference test in which they choose between the two rewards. This serves as a way of having the dogs rate the rewards. If they have a preference, they should eat one type of treat more frequently than the other.

The two treatments differ in how the unpleasant noises are presented. In the contingent treatment, the noises always precede the dog treats by half a second. In the non-contingent treatment, the noises precede the dog treats, but at random times (anywhere from 15 seconds to half a second before). The randomness of the noises is meant to prevent dogs from thinking the noises predict the appearance of a dog treat, thus discouraging them from thinking they are "earning" the treat.

Methods

Subjects

Twenty-one dogs from Bloomington, IL were recruited to participate in this experiment. Dog owners were emailed with details about the experiment and were given a schedule to sign up. Nine of them were pure-bred (2 golden retrievers, 1 coonhound, 2 cocker spaniels, 1 pug, 3 Labrador retrievers) and 12 of them were mixed breeds (pitbull/beagle, golden retriever/lab, pug/Boston terrier, Aussie/retriever, pitbull/Mastiff, beagle/German shepherd/hound, golden retriever/poodle, shepherd/beagle/terrier, Labrador/great Pyrenees, Pomeranian/Schipperke, Border Collie/Cattle dog). Ages ranged from 1 to 12 with the average being 7. Ten of the dogs had formal obedience training in the past.

Ten of the dogs dropped out or had to have their data disregarded. Seven of these stopped eating the treats midway through the experiment. The other 3 did not eat the treats from the beginning. Dogs were recruited through email and in person from a database of dog owners who had registered their dogs to participate.

Materials

A "treat machine" was built using foam-core and chrome duct tape that concealed a speaker emitting loud bell sounds – loud (70 dB) for mildly unpleasant and very loud (97 dB) for very unpleasant (decibels were measured using the iPhone app *Decibel 10^{th}*), and two tubes extending downwards in which the dog treats were dropped and expelled through by a hidden experimenter (See Figure 2). The experimenter was concealed in a 60cm x 60cm x 120cm box, composed of a PVC pipe frame with opaque cloth attached to each side (See Figure 2). The experimenter was able to access the "treat machine" and drop treats through a medium size hole in the front fabric panel. The dog treats used were green and orange homemade treats made of pumpkin, peanut butter, and flour. Originally we intended to use blue and yellow treats because they are colors most distinguishable for dogs. However, our recipe only allowed us to achieve a close approximation, yielding green and orange. The color of treat was always consistent with which sound was played (orange with very unpleasant, green with mildly unpleasant), but which color was paired with which sound varied across dogs.

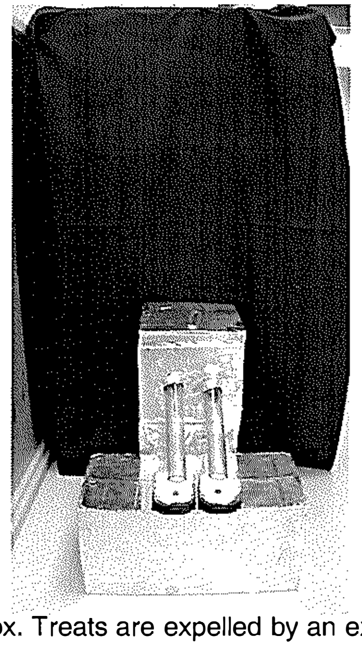

Figure 2. "Treat machine" and hiding box. Treats are expelled by an experimenter hidden inside cloth box through clear PVC pipes into two separate dishes.

A Microsoft Powerpoint presentation was constructed for the contingent and non-contingent treatments in which the unpleasant sounds played automatically through the timing of the slides. Following each sound slide was a slide instructing the experimenter to drop a treat at a specific time. This Powerpoint presentation ensured that the timing of the sounds was standardized across subjects and that the experimenter dropped the treats at consistent intervals. The presentation was played via a 13-inch MacBook Pro and was also hidden from the dogs in the box.

Procedure

The experiment took place either at our campus lab or at a local dog daycare. Each dog first entered the room and was given time to acclimate to the room and experimenters. After a few minutes, dogs started the first phase of the experiment – the preference test. Here, they were presented with two treats on two plastic spoons or paper plates by the experimenter as another experimenter held the dogs back, approximately 120 centimeters away. After being held for 3 seconds, the dogs were allowed to choose only one of them (Treats were held far enough away from each other that the dog could not eat both. After the dog ate one, the experimenter would quickly pull the other out of reach). This experimenter was blind to the critical color so as to prevent them from influencing dogs' choices. Dogs' choices were recorded on paper and via video camera. This was repeated 12 times.

Next, dogs entered the "treat machine" phase in which they heard loud bell noises followed by the treat machine emitting a treat. In the contingent condition, the speaker was placed in the machine so that the noise came from the same place where the treats were emitted. The sound and treat were both released at regular intervals with the treat always releasing one second after the noise began. This regular interval ensured that the dogs learned that the noise indicated that a treat was about to appear. Thus, they should have learned to associate the aversive stimuli with the reward. In the non-contingent condition, the speaker was placed on the other side of the room rather than in the machine so that noise would be less likely to be associated with the treats. The treats were still released on a consistent schedule, but the preceding noise was produced randomly (from 1 to 15 seconds before, with an average of 7 seconds). In this condition, the dogs should have learned to disregard the noise since it had no predictive value for the appearance of the treats. Thus, in this condition the reward should not have seemed to depend on the noise.

A manipulation check to test for this was implemented by having dogs videotaped and video analyzed later. We did this by measuring how quickly and how often dogs looked at the speaker and "treat machine" after hearing the noise (if at all). In the contingent treatment, the dogs should have known that they were about to be rewarded when they heard the noise. If they perceived a relationship between the noise and the treat, they should have looked at the "treat machine" and speaker after the noise more quickly and more often than the dogs in the non-contingent condition. In the non-contingent condition, the dogs should not have anticipated a reward after hearing the noise. Thus, they should not have looked at the "treat machine" and speaker as quickly or as often as those in the contingent treatment after the noise sounded. The critical reaction time period in both treatments was from when the noise sounded to 1 second afterwards. Dogs were only counted as looking if they looked at the speaker or the "treat machine" where the treats were normally released. Note, however, that because the "treat machine" and speaker were in two different locations in the non-contingent treatment, dogs were twice as likely to be counted as looking (This fact was unaccounted for when the manipulation check was designed). After all measurements were taken, they were coded and checked for inter-rater reliability.

In each treatment, mildly and highly aversive noises were emitted before their corresponding treats, 12 times each. Noise-treat pairs alternated regularly (mild noise with orange treat, loud noise with green treat, mild noise with orange treat, etc.) In both conditions the treats were scheduled to release every 20 seconds. In the contingent treatment, the noise always preceded the treat by half a second. In the non-contingent treatment, while the noise always preceded the treat, it did so at random times within a 15-second time window.

After all dogs finished the treat machine phase, they moved on to the third phase: another treat-rating phase. This phase was identical to the first preference test. After choosing from the treats 12 times, the dogs completed the experiment.

Results

For our manipulation check (seeing whether the dogs formed an association between the noise and treat) we used a Mann-Whitney U test to compare the amount of times dogs looked at both the machine and speaker in each treatment. The medians of looks in the contingent and non-contingent treatment were 13 and 7, respectively, indicating a marginally significant effect of treatment ($p = .082$). Though this is only marginally significant, it is worth noting that in the non-contingent treatment the machine and speaker were separate, therefore giving dogs twice as many opportunities to be counted as looking. This fact adds further weight to the result of our manipulation check and suggests that it was successful – that in the contingent treatment, dogs really were paying attention in the treat machine phase and formed an association between noise and treat.

We used non-parametric tests to analyze our data in order to increase power due to our small sample size and because our data violated the assumption of normalcy. To explore whether each dog changed their preference we conducted a series of binomial tests. To do this, we calculated at how many times the dogs chose the treat associated with the severe noise before and after the treat machine phase. In the contingent treatment, only one (out of five) dogs had a significant preference shift (from choosing the severe treat five times (out of twelve) to choosing it eight times). In the non-contingent treatment, only one dog had a significant preference shift – this time in the opposite direction (from choosing the severe treat nine times to choosing it five times)(See Table 1). We thus conclude that the effort justification effect was not demonstrated in either treatment – dogs in both treatments had no preference for either treat before or after the treat machine phase.

Table 1

Dogs' choices of severe treat in preference tests.

Subject	Treatment	Before	After	After - Before
1	Contingent	7	7	0
2	Contingent	6	7	1
3	Contingent	5	5	0
4	Contingent	5	8	3*
5	Contingent	6	6	0
6	Non-Contingent	6	6	0
7	Non-Contingent	5	7	2
8	Non-Contingent	5	5	0
9	Non-Contingent	3	4	1
10	Non-Contingent	5	5	0
11	Non-Contingent	9	5	-4*

*$p < .05$

We also ran a Mann-Whitney's U test to evaluate the overall difference in the dogs' choices of treats between the contingent and non-contingent treatment. We did not find a significant effect of treatment (the mean ranks of Contingent and Non-Contingent were 0.8 and -0.16, respectively; $p = .662$). Thus, dogs' choices of severe treat were not significantly different between the contingent and non-contingent treatments. In conclusion, the effort justification effect was not found in either treatment.

Discussion

The purpose of this study was to see if dogs demonstrate the effort justification effect and more broadly, cognitive dissonance. In order to determine the latter, we had to rule out contrast theory by separating dogs into contingent and non-contingent treatments. Finding the effect only in the contingent treatment would rule out contrast theory as an explanation. This is because contrast theory predicts the effort justification effect to happen in both treatments since it is not relevant to the theory whether dogs form an association between the task and reward. Our manipulation check revealed a marginally significant effect in treatment -- dogs looked more often at the treat machine and speaker in the contingent treatment. This supports the idea that dogs understood that the noises predicted the appearance of treats in this treatment. However, because we failed to find the effort justification effect in either treatment and the treatments were the same in terms of dogs' treat preferences, we cannot draw any conclusions about whether dogs can demonstrate the effort justification effect or whether they experience cognitive dissonance.

There are multiple possible explanations for the failure to find the effort justification effect in either treatment. One may be due to our small sample size. This was due to time constraints, difficulty recruiting dog owners, and a high dropout rate (many of the dogs were either too scared of the noises to participate or were not sufficiently food-driven). We would have been more likely to find a significant effect with more dogs because larger sample sizes more reliably reflect the actual population of dogs. Because we used relatively few dogs in our study, our results were more likely to have been affected by outliers. Our low sample size also gives us relatively low statistical power.

It is curious that the dogs did not form a preference for one of the treats – even in the opposite direction predicted by our hypothesis. Our experiment is basically one of classical conditioning. Each noise is consistently paired with one of the colored treats. Classical conditioning would predict that the dogs would form an association between each noise/treat pairing simply due to the fact that each treat consistently follows a noise. Because one noise is milder and less annoying than the other, classical conditioning would predict that the dogs would prefer the mild noise's treat. The fact that this was not the case suggests two possible limitations: that the difference between the treats was not salient enough and/or that the difference between the noises was not salient enough.

If the difference between the two treats – their color – was not salient enough, the dogs would not be able to discriminate between them and therefore would not associate each treat with its corresponding noise. Thus, the dogs would be not form a preference for one treat over the other. Though we took into account that most dogs are red-green colorblind, our recipe only allowed us to create green and orange treats. Preferably we would have presented them with blue and yellow treats since they are more likely to be within dogs' color detection range. It may have been the case that the dogs did not pay much attention to this difference in color. Future studies could improve upon this by implementing some validity check, thereby showing that dogs will in fact form a preference for one of the colors. Additionally, they could use features other than color to distinguish the two treats including taste, shape, or texture. As long as the dogs do not initially have a preference for either, this should not pose any problems.

If the difference between the two noises was not salient enough (in annoyingness), we again would not expect the dogs to form a preference for one treat over the other. If dogs were unable to discriminate between the two noises at all, they would not have formed the associations between each noise and its corresponding treat that is required to prefer one treat to the other. Similarly, if dogs were able to discriminate between the noises, but did not find one noise significantly more annoying than the other, they would have no reason to prefer one treat to the other. Future studies could address this limitation by implementing a manipulation check that makes sure dogs find one noise more annoying than the other.

Another potential limitation was the task given to the dogs. Due to the lack of time, we were forced to choose a task that required no training for our experiment. The task we chose was for dogs to hear an annoying noise before they received a treat. Though this undoubtedly put dogs in a negative hedonic state (many dogs dropped out due to fear of the treat machine), it is an admittedly passive task. While the effort justification effect has been found with humans who were given the similarly passive task of enduring shocks (Gerard and Matthewson, 1966), this may be regarded as being a more effortful task because the humans were given verbal instructions about how the enduring the shocks was part of an experiment and understood that they could leave at any time – thus their endurance of the shocks may have felt more like a choice than the dogs' endurance of the noises.

While our experiment has ultimately been inconclusive, the general methodology of this experiment may still be viable for use in future studies. Moreover, the logic of Gerard and Matthewson's (1966) version of the effort justification paradigm is still just as sound and it is still available to be implemented in studies of nonhuman animals. Future studies may benefit by the learning from our experiment's limitations. This may be done by choosing a more effortful and active task, making sure the animal distinguishes between the rewards, and using a larger sample size.

Behaviorists may still rightfully argue that contrast theory is the more parsimonious explanation for the effort justification effect in animals. Contrast theory makes fewer assumptions about the mechanism in animals responsible for the effort justification effect (Lydall et al., 2010). And because this experiment has not ruled it out, it should still remain the choice explanation. However, before it is said that contrast theory is the *right* explanation, researchers need to conduct an experiment that effectively pits cognitive dissonance against contrast theory.

Our failure to find the effort justification effect does not indicate that dogs or nonhuman animals cannot produce it. This failure may be due to the limitations mentioned above or some that have not been accounted for. Furthermore, because we did not find any significant difference in dogs' rating between treatments, we cannot draw conclusions about whether cognitive dissonance or contrast theory is a better explanation for the effort justification effect. It still remains a possibility that dogs and other nonhuman animals experience cognitive dissonance. And so long as this possibility exists, cognitive dissonance as a human phenomenon will continue to be only partially understood.

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